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The Chordeumatid Millipeds of Chile (Diplopoda, Chordeumatida)

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ABSTRACT

The family Eudigonidae (Heterochordeumatoidea) is confirmed for the genera *Eudigona* Silvestri, *Apodigona* Silvestri, and *Ancudia,* new genus. The known distribution of the family is limited to central Chile. The closest relatives of the Eudigonidae would appear to be the Metopidiotrichidae of southeastern Asia and New Guinea, but clear synapomorphies uniting the two families have not yet been found. The following new taxa are described: *Ancudia chepu, Apodigona platnicki,* and *A. franckei. Eudigona chilensis* Silvestri is redescribed from new specimens.

INTRODUCTION

In 1903, Filippo Silvestri published a survey of the millipeds of Chile in which he described *Apodigona abbreviata* and *Eudigona chilensis,* the first chordeumatids reported from the South American continent. He placed the two species in two new monotypic genera and in the family Heterochordeumatidae, which at that time contained all the chordeumatid millipeds we would now consider to be of Gondwanan origin. Despite Silvestri's accurate illustrations (Silvestri, 1905), controversy arose as to the systematic position of the Chilean genera.

Attems (1907) placed both genera in his new family Metopidiotrichidae, narrowing the concept of Heterochordeumatidae to the type genus. Verhoeff (1914) put them in Conotylidae, at the same time dividing that family into four subfamilies: Japanosominae, Eudigoninae (*Eudigona* only), Conotylinae, and Trichopetalinae (*Trichopetalum* and *Zygonopus* of North America, and *Apodigona*).[2]

Chamberlin (1957) found no new material of chordeumatids in the large collections assembled by the Lund University Chile Expedition, and followed Verhoeff in placing

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[2] While the subfamilies Japanosominae (*recte*: Japanosomatinae), Trichopetalinae, and Eudigoninae correctly can be attributed to Verhoeff, he missed the earlier proposal of the family name Conotylidae by Cook (1896).

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Silvestri's two genera in Conotylidae. In 1972, I pointed out an apparent relationship between Metopidiotrichidae and Conotylidae, assembling a superfamily Heterochordeumatoidea from those two families and the families Diplomaragnidae, Adritylidae, Heterochordeumatidae, and Japanosomatidae (this latter name is a synonym of Conotylidae, Conotylinae [Shear, in press]). I rejected Verhoeff's suggestion that *Apodigona* belonged in the Trichopetalidae, which family I placed in the unrelated superfamily Cleidogonoidea.

Following this initial assault on the thicket of North American and Asian chordeumatid milliped nomenclature and phylogenetics, my colleagues Sergei Golovatch (Moscow), Jean-Paul Mauriès (Paris), and I have proposed a series of different schemes for the classification of this group of genera. The two most recent schemes (reviewed in Golovatch, 1986; Mauriès, in press) are quite different from each other, and both differ from my current ideas. Rather than present yet another arrangement in the context of incomplete information, I plan first to finish studies of all relevant taxa similar to my treatments of the family Conotylidae (1971, 1972, 1976). A series of papers redescribing enigmatic taxa (i.e., Shear, in press) has been completed, and a revision of the large family Diplomaragnidae, which may involve as many as 30 species, is in progress. With these works and those of Golovatch and Mauriès as sources of data, a cladistic analysis of the group can be undertaken to provide a basis for biogeographic hypotheses. In addition to the now-classic vicariance hypotheses, circum-Pacific millipeds may be ideal for tests of the Pacifica hypothesis (see Jeekel, 1984) or the newer proposal of secondarily reduced bipolar distributions (Eskov and Golovatch, 1986), although finding unequivocal tests of these ideas is difficult.

The new material described below, crucial in this long-range project, comes from Norman Platnick of the Department of Entomology of the American Museum of Natural History, who, in company with Oscar Francke, collected extensively in Chile in 1985. In 1986, Platnick was accompanied on a return trip to Chile by R. T. Schuh. Using litter sorting and Berlese sampling techniques, they were able to collect chordeumatid millipeds in Chile for the first time in more than 80 years. Included in their finds were new specimens of *Eudigona chilensis,* two new species of *Apodigona,* and representatives of a new genus, *Ancudia.*

Examination of this material confirms the placement of the Eudigonidae in the superfamily Heterochordeumatoidea, but the position of *Apodigona* is more difficult to assess. Silvestri did not have females, which were included in the new collection. Females have 32 segments, whereas the males have 30. The anterior gonopods of *A. abbreviata* were not illustrated by Silvestri, but according to his description were quite similar to the anterior gonopods of the two new species. These gonopods share with those of *Ancudia* a median coxosternal lamella. The modifications of the male seventh coxae in *Apodigona* are also like those of *Ancudia.* In turn, *Ancudia* is linked to *Eudigona* by the enormously inflated posterior gonopod telopodites (not so large in *Apodigona*). For these reasons, as well as geography, I am including *Apodigona* in Eudigonidae.

ACKNOWLEDGMENTS

Professor G. Viggiani, of the Istituto di Entomologia Agraria, Portici, Italy, kindly loaned me the type slides of *Eudigona chilensis* and *Apodigona abbreviata.* As usual, I am indebted to Jean-Paul Mauriès (Museé National d'Histoire Naturelle, Paris) and Sergei Golovatch (A. N. Svertlov Institute, Moscow) for sharing with me unpublished and manuscript data on new discoveries in chordeumatid millipeds. Norman Platnick and Rowland Shelley are thanked for their comments on the manuscript.

All material reported in this paper has been deposited in the collections of the American Museum of Natural History, New York.

SYSTEMATICS

SUPERFAMILY HETEROCHORDEUMATOIDEA

FAMILY EUDIGONIDAE VERHOEFF

Heterochordeumidae: Silvestri (not Pocock 1894; not including *Heterochordeuma*), 1903: 10; 1905: 723.

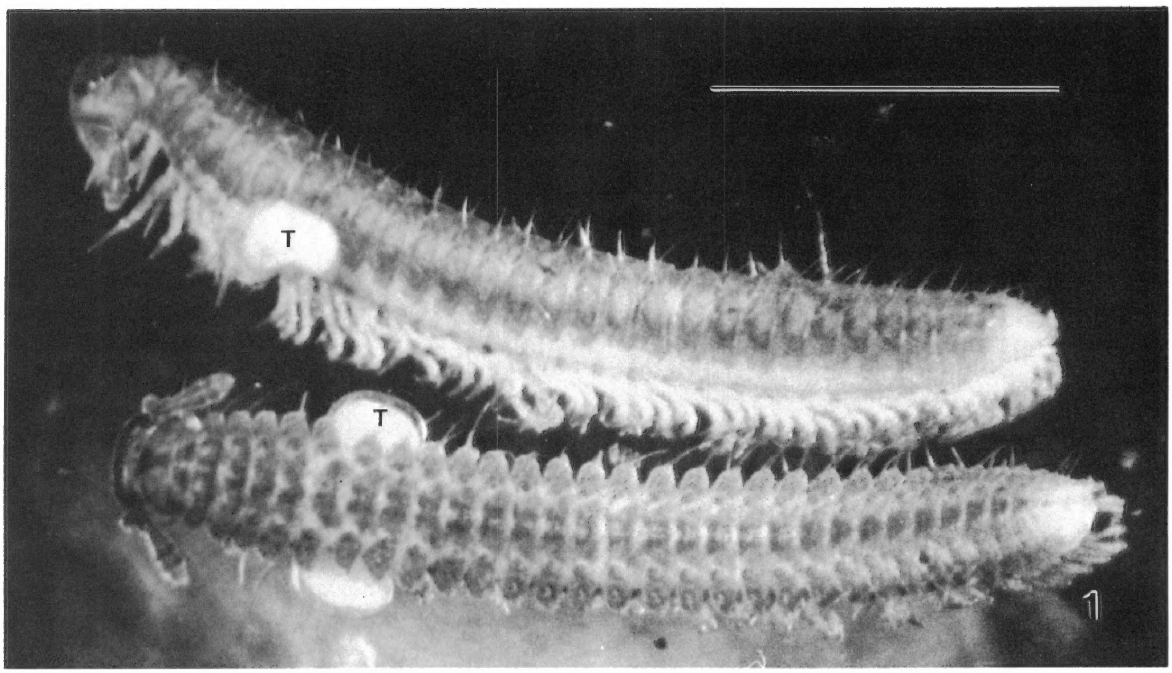


Fig. 1. *Ancudia chepu,* new species. Two males, one (above) in lateral view, and one (below) in dorsal view, to show proportions and positions of posterior gonopod telopodites (T). Scale line = 2 mm.

Metopidiotrichidae: Attems (not including *Metopidiothrix*), 1907: 123.
Eudigoninae Verhoeff, 1914: 346.
Eudigonidae: Mauriès, 1978: 64.
Apodigoninae: Verhoeff, 1914: 346. NEW SYNONYMY.

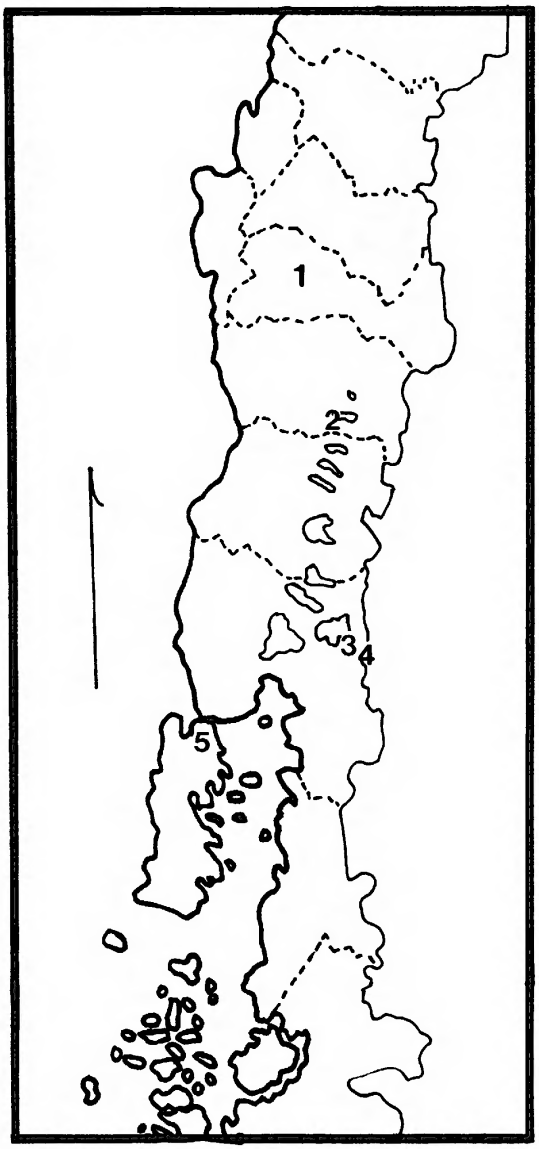
DIAGNOSIS: Schedotrigonidae and Metopidiotrichidae have the telopodites of legpair 10 strongly reduced, set on modified coxosterna, and with very large, pigmented glands extending dorsally into the body cavity; Schedotrigonidae and Lankasomatidae have sheathed flagella on the anterior or posterior gonopods; all conotyloids (Conotylidae, Adritylidae, Megalotylidae) have 30 segments in both sexes. The genera of Eudigonidae are united by the synapomorphy of spectacularly enlarged terminal segments of posterior gonopods (figs. 1, 4, 12, 17).

DESCRIPTION: Thirty-two or 30 segments in males, 32 segments in females. Mentum not divided. Males with coxal glands on legpair 10 (fig. 18) only, coxae (figs. 9, 14) or prefemora (fig. 2) of legpair 7 modified. Anterior gonopods with coxosternal process or lamella (figs. 3, 6, 11, 15), telopodites fused to coxosternum or separate. Posterior gonopods with single colpocoxite or complex group of fimbriae, apical segment of telopodite very large, appressed to lateral surface of body (fig. 1).

INCLUDED GENERA: *Eudigona* Silvestri, *Apodigona* Silvestri, *Ancudia* new genus.

DISTRIBUTION: Central Chile (Map 1).

NOTES: In all species of this family at least one branch of the anterior gonopod, or a short triangular process from it, is lateral to the colpocoxite of the posterior gonopod. This suggests a relationship with the family Metopidiotrichidae of southeastern Asia and New Guinea, but in that family the tenth coxae of males are very much enlarged, with huge pigmented glands that extend dorsally into the body cavity, and the tenth telopodites are nearly absent. Like heterochordeumatids, eudigonids have tenth coxae that are somewhat modified (fig. 18), but the telopodites retain all seven segments, being only slightly smaller (about $\frac{5}{6}$ the size) than the eleventh telopodites. The sternal process of the anterior gonopods is an obvious homolog of the same structure in schedotrigonids.



Map. 1. Central Chile, showing localities at which eudigonid millipeds have been collected. **1,** Coipué (*Apodigona abbreviata* and *Eudigona chilensis* type locality). **2,** Lago Villarica (*E. chilensis*). **3,** Puyehue region (*A. franckei*). **4,** Volcán Osorno (*A. platnicki*). **5,** Ancud region (*Ancudia chepu*). See species accounts for detailed locality information.

The description of the family given by Mauriès (1978) is no longer correct. It was based on the drawings of Silvestri (1905), contained misinterpretations, and applies only to *Eudigona chilensis.*

KEY TO GENERA

1a. Males with 30 segments; posterior gonopod telopodites clavate; anterior gonopod telopodites each with a lateral triangular process ..... *Apodigona* Silvestri

1b. Males with 32 segments; posterior gonopod telopodites cushionlike, dorsoposteriorly flattened 2

2a. Posterior gonopod colpocoxites with branches composed of numerous fimbriae; anterior gonopod coxosternal process a thin lamella ..... *Ancudia,* new genus

2b. Posterior gonopod colpocoxites without fimbriae; anterior gonopod coxosternal process a straight rod ..... *Eudigona* Silvestri

Eudigona Silvestri

Eudigona Silvestri, 1903: 10; 1905: 723 (type species by original designation *Eudigona chilensis* Silvestri).

DIAGNOSIS: *Eudigona* may be separated from other eudigonid genera by the more complex anterior gonopods, consisting of a coxosternal process and three telopodite branches; in the single known species, the seventh legs of the males have strongly modified prefemora.

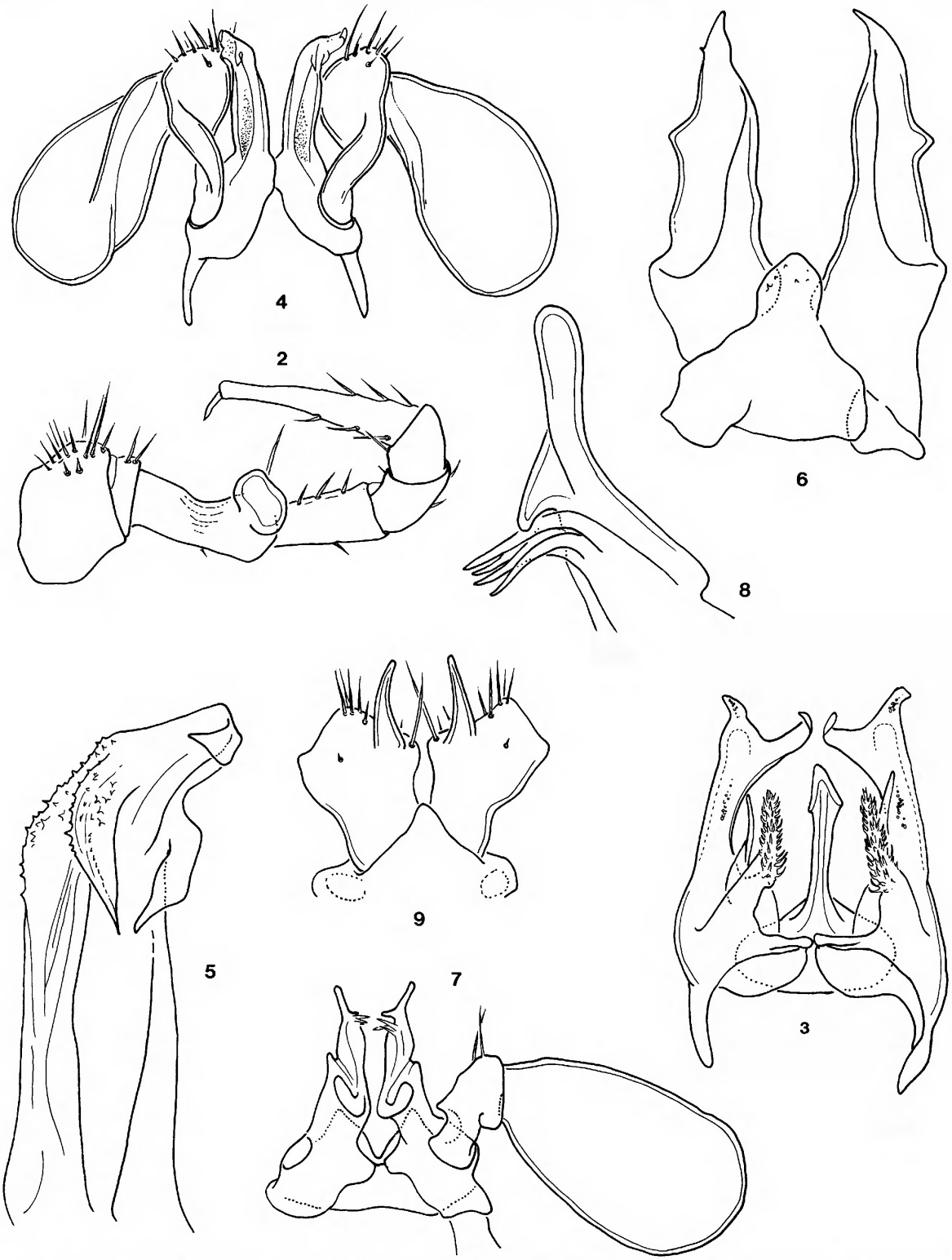
Eudigona chilensis Silvestri

Figures 2–5

Eudigona chilensis Silvestri, 1903: 10–11; 1905: 724, figs. 24–29 (male holotype from Coipué, Chile [35°15′S, 72°4′W; see Notes, below] deposited in Istituto di Entomologia Agraria, Portici, Italy, examined).

MALE (from Bellavista, Chile): Length, 7.0 mm, width 0.78 mm. Antennal segment 3 0.23 mm long. Ocelli 16, in subrectangular patch, well pigmented. Metazonites with well-developed paranota, sides below paranota with 8–10 pronounced striae. Segmental setae robust, curved, with clear cortex, darkly pigmented central stele. Pigmentation dark, irregularly mottled brown, telson and last segment white, legs creamy white. Posterior gonopod telopodites clearly visible in dorsal view, dark glossy brown; paranota of seventh segment set higher than on other segments to accommodate them.

Legpair 7 (fig. 2) with coxae slightly larger than those of legpair 6; prefemora deeply excavate posteriorly, apicoventral angle drawn



Figs. 2–9. 2–5. *Eudigona chilensis* Silvestri. **2.** Left leg 7, posterior view. **3.** Anterior gonopods, posterior view. **4.** Posterior gonopods, posterior view. **5.** Colpocoxite of left posterior gonopod, posterior view. 6–9. *Apodigona platnicki,* new species. **6.** Anterior gonopods, anterior view. **7.** Posterior gonopods, posterior view. **8.** Tip of colpocoxite of left posterior gonopod, posterior view. **9.** Coxae of legpair 7, posterior view.

out in large knob. Anterior gonopods (fig. 3) with partially fused coxosternum bearing long, apically triangular process; telopodites with three branches, anteriormost distally broadly expanded, with mesal hooks inserting between colpocoxites of posterior gonopods; posteriormost branch blunt, shorter, densely set with small cuticular hooks; mesal branch simple, curved lamella. Posterior gonopods (figs. 4, 5) with sternum much reduced, gonopod coxae touching but not fused. Colpocoxite a single, laterally curved branch bearing three retrorse hooks posterioapically. Prefemora large, flattened and curved, setose; apical telopodite articles enormously enlarged, flattened, cushionlike, appressed to sides of metazonites of seventh segment.

Tenth legpair with enlarged coxae bearing glands; gland apertures with distinct lamellate lips; telopodites with usual seven segments but distinctly smaller than eleventh telopodites.

FEMALE: Length, 6.5 mm, width 0.94 mm. Antennal segment 3 0.26 mm long. Ocelli 14, pigmented, in oval patch. Pigmentation and nonsexual characters as described for male.

NEW RECORD: CHILE: Cautin Prov., Bellavista, native forest on north shore of Lago Villarica, elev. 305 m, Jan. 28, 1985, N. Platnick, O. Francke, 5 males, 2 females, juveniles; elev. 260 m, Jan. 30, 1986, N. Platnick, R. Schuh, 3 males, juveniles.

NOTES: The specimens reported and described here match Silvestri's 1905 illustrations. Unfortunately, the type specimen consists only of some midbody segments mounted permanently on a slide. Silvestri described only males but implicitly compared the holotype with a female, so it may be that other specimens were available to him and have not survived.

There are about a half dozen places named Coipué in Chile. Norman Platnick investigated old gazeteers and maps (of 1940s vintage) and found only one town of that name large enough likely to have been in existence in the 1890s and early 1900s; this is the place shown on my map.

Apodigona Silvestri

Apodigona Silvestri, 1903: 11; 1905: 724 (type species by original designation and monotypy *Apodigona abbreviata* Silvestri).

DIAGNOSIS: *Apodigona* differs from *Eudigona* and *Ancudia* in having 30-segmented males and in the clavate, unflattened telopodites of the posterior gonopods.

Apodigona abbreviata Silvestri

Apodigona abbreviata Silvestri, 1903: 11; 1905: 725, figs. 30–34 (male holotype from Coipué, Chile, in Istituto di Entomologia Agraria, Portici, Italy, examined).

NOTES: Because the holotype specimen consists of only a few midbody segments mounted on a microscope slide, Silvestri's illustrations have been used to place two new species in this genus; all have quite similar posterior gonopods. The anterior gonopods of *abbreviata* were not illustrated, but described as subacute triangular laminae. If Silvestri had females, he may have neglected to count segments, and thus missed the point that females differ in this respect from males. Alternatively, *abbreviata* may indeed have 30 segments in both sexes.

The two new species described below are from two localities near each other but about 300 mi south of the type locality for *abbreviata*. Previous experience with other montane chordeumatid genera suggests that *Apodigona* may contain many additional species and may be quite useful in biogeographic work in the Chilean Andes.

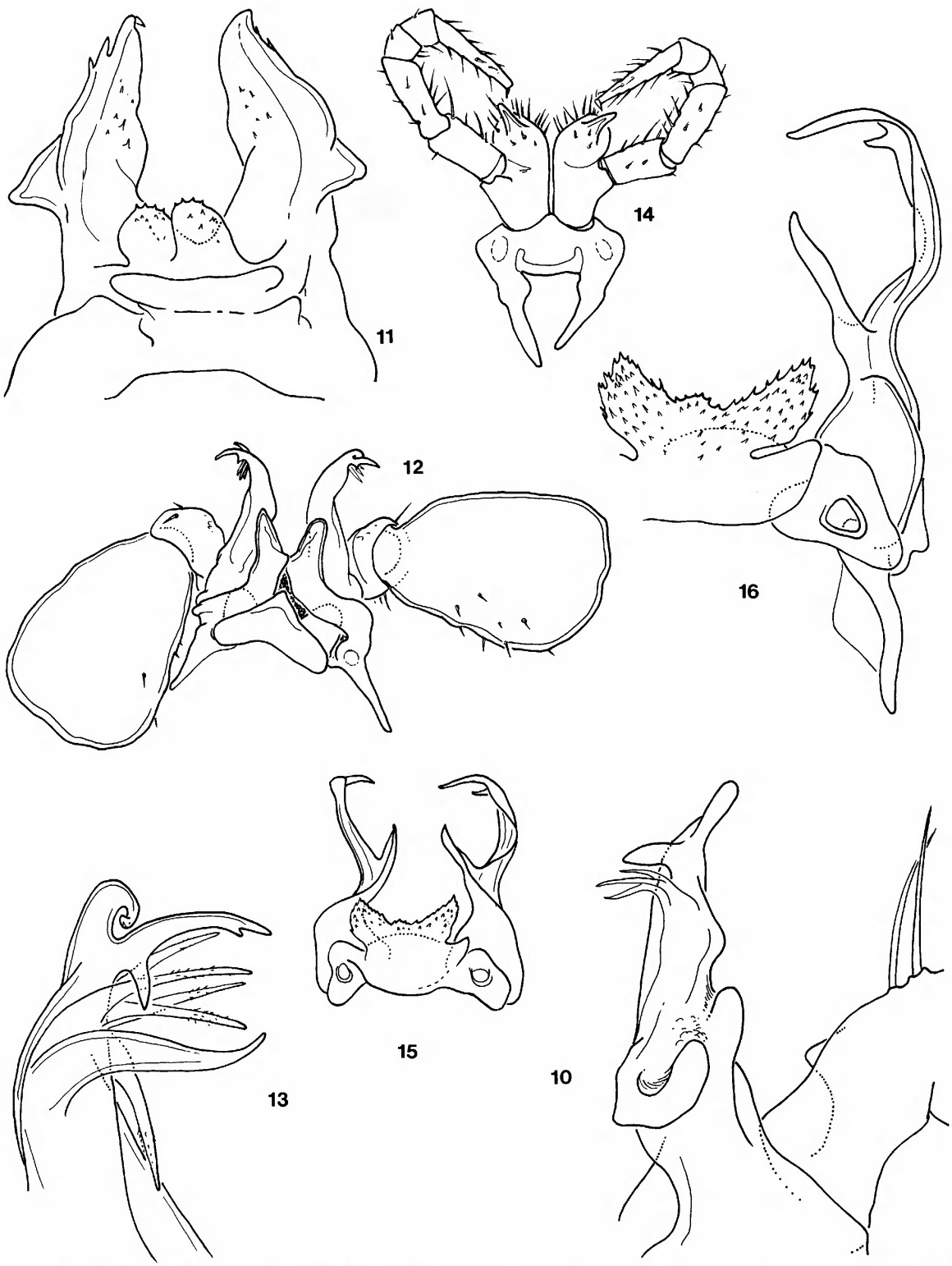
Apodigona platnicki, new species
Figures 6–10

TYPES: Male holotype and female paratype (AMNH) from Volcán Osorno, Osorno Prov., Chile, mature forest, elev. 610 m, Feb. 12, 1985 (N. Platnick, O. Francke).

ETYMOLOGY: The species name honors Norman Platnick of the American Museum of Natural History, who organized Chilean collecting trips in 1985 and 1986.

DIAGNOSIS: According to Silvestri's (1905) illustrations, *A. abbreviata* has the tips of the posterior gonopod colpocoxites attenuate, and the midlength branch long and acute; *A. franckei* (described below) has a curved posterior gonopod colpocoxite tip and pronounced subtriangular lateral processes on the anterior gonopods.

MALE: Thirty segments. Length, 4.9 mm,



Figs. 10–16. **10.** Colpocoxite of left posterior gonopod of *A. platnicki,* posterior view. 11–13. *Apodigona franckei,* new species. **11.** Anterior gonopods, anterior view. **12.** Posterior gonopods, anterior view. **13.** Tip of colpocoxite of left posterior gonopod, posterior view. 14–16. *Ancudia chepu,* new species. **14.** Legpair 7, posterior view. **15.** Anterior gonopods, anterior view. **16.** Sternite and right anterior gonopod, anterior view.

width 0.68 mm. Antennal segment 3 0.16 mm long. Ocelli 21, pigmented, in triangular eyepatch. Paranota of metazonites prominent, horizontal, squarish. Segmental setae acute, robust, curved, about ⅓ as long as body width. Surface of segments finely granulate, subparanotal striae present on metazonites. Pigmentation dark brown with mottling of purplish black on paranota and metazonites; last two segments and telson colored as preceding segments.

Legpair 7 with coxae enlarged, bearing acute, slightly curved processes on posterior surfaces (fig. 9). Anterior gonopods with small, membranous median sternal lobe; telopodites elongate-triangular, lateral process small (fig. 6). Posterior gonopod colpocoxites (figs. 7, 8, 10) large, upright, with prominent posterior midlength lobe; apex clavate; cluster of acute spines with small cuticular bristles subtended by short, decurved subapical branch (fig. 8). Prefemur shorter than colpocoxite, mesally excavate; apical segment much swollen but not flattened, not appressed to metazonite of seventh segment. Legpair 10 coxae slightly enlarged, with lateral lobes, glands; telopodites with usual seven segments, about ¾ size of telopodites of legpair 11.

FEMALE: Thirty-two segments. Length, 6.0 mm, width, 0.78 mm. Antennae missing from paratype. Ocelli 23, eyepatch oval. Pigmentation and nonsexual characters as in male.

DISTRIBUTION: Known only from the type locality.

Apodigona franckei, new species

Figures 11–13

TYPES: Male holotype, two male paratypes, three female paratypes and numerous immature specimens (AMNH) from 1 km east of Termas de Puyehue, Osorno Prov., Chile, collected in wet forest Jan. 31, 1985 (N. Platnick, O. Francke).

ETYMOLOGY: The species name honors Oscar Francke, formerly of Texas Tech University, and a recognized authority on scorpions.

DIAGNOSIS: See under *A. platnicki*, above.

MALE: Thirty segments. Length, 5.28 mm, width, 0.57 mm. Antennal segment 3 0.16 mm long. Ocelli 19, arranged in irregular rows in oval eyepatch. Form of segments as described for *A. platnicki*. Pigmentation light grayish tan, paranota dark brown, dark brown spot in midline of metazonites, giving appearance of three dark stripes on light ground.

Coxae of legpair 7 modified as in *A. platnicki*. Anterior gonopods (fig. 11) with more prominent, bilobed median sternal process, curved posteriad, triangular lateral process prominent. Posterior gonopods (figs. 12, 13) with colpocoxites somewhat laterally curved, midlength posterior projection not so prominent as in *platnicki*. Apex complicated, as shown in figure 13.

Tenth legpair with coxal glands, telopodites about ¾ as large as telopodites of eleventh legpair.

FEMALE: Thirty-two segments. Length, 5.72 mm, width, 0.66 mm. Antennal segment 3 0.18 mm long. Ocelli 24, eyepatch rounded-triangular. Pigmentation and nonsexual characters as in male.

DISTRIBUTION: CHILE: Osorno Prov., Aguas Calientes, Parque Nacional Puyehue, primary forest litter, elev. 430 m, Jan. 28, 1986, N. Platnick, R. Schuh, 4 males, 3 females, juveniles; 6–8 km SE Aguas Calientes, elev. 600–700 m, Jan. 28, 1986, N. Platnick, R. Schuh, male.

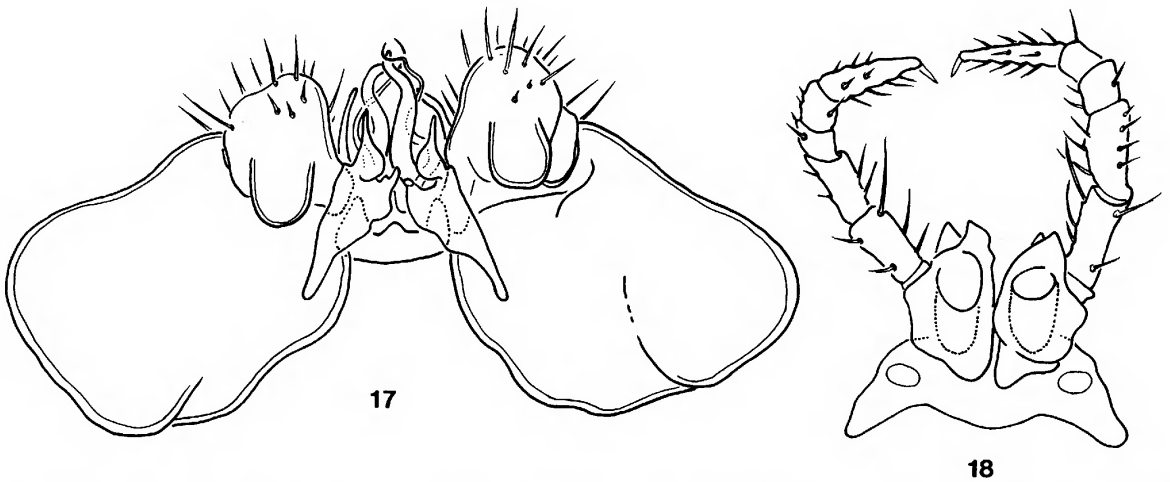
Ancudia, new genus

TYPE SPECIES: *Ancudia chepu*, new species.

ETYMOLOGY: The genus name is formed from Ancud, principal city of Isla de Chiloé and Chiloé Province, Chile, near which the type specimens of the type species were taken. It should be treated as feminine.

DIAGNOSIS: *Ancudia* is distinct from other eudigonid genera in the several fimbriate branches of the colpocoxites of the posterior gonopods.

DESCRIPTION: Thirty-two segments in males and females. Segmental paranota prominent, metazonital surfaces covered with acute granules, with 6–8 prominent lateral striae below paranota. Seventh coxae of males enlarged, with acute posterior thorn. Anterior gonopods with prominent median sternal lobe, telopodites widely separated, two-branched, with lateral branch passing between posterior gonopod colpocoxites and



Figs. 17, 18. *Ancudia chepu,* new species. **17.** Posterior gonopods, posterior view. **18.** Legpair 10, anterior view.

prefemora. Posterior gonopod colpocoxites with three bundles of cuticular fimbriae, posterior lamellate branches. Apical telopodite segment enormously enlarged, flattened, appressed to lateral surface of seventh metazonite, paranota of which are set higher on segment than in other segments. Tenth coxae with glands, telopodites seven-segmented but smaller than telopodites of eleventh legs.

DISTRIBUTION: Isla de Chiloé, Chile.

Ancudia chepu, new species
Figures 1, 14–19

TYPES: Male holotype, one female, and two male paratypes (AMNH) from Chepu, Chiloé Prov., Chile, collected in wet forest at an elevation of 15 m, Feb. 2, 1985, by N. Platnick and O. Francke.

ETYMOLOGY: The species epithet is a noun in apposition, after the type locality.

DIAGNOSIS: See generic diagnosis.

MALE: Length, 5.7 mm, width, 0.78 mm. Antennal segment 3 0.23 mm long. Ocelli 24, pigmented, in subtriangular eyepatch. Paranota prominent, squarish; metazonital surface covered with small, acute granules; 6–8 prominent longitudinal striae below paranota. Segmental setae long, about half as long as body width, robust, curved, acute. Color mottled gray, brown, and purplish, not giving striped appearance of *Apodigona*; last two segments and telson white, legs white. Telopodites of anterior gonopods visible from above (fig. 1), glossy brown.

Legpair 7 (fig. 14) with enlarged, lobed coxae bearing acute posterioventral process; telopodites somewhat smaller than telopodites of sixth legpair. Anterior gonopods (figs. 15, 16) with large anterior sternum bearing bilobed membranous median process, set with many small cuticular teeth; telopodites two-branched, mesal branch short, simple, erect, lateral branch sinuously curved, with subdistal tooth, extending in situ between posterior gonopod colpocoxites and prefemora. Posterior gonopods (figs. 17, 19) with complex colpocoxites: two anterior branches made up of closely appressed cuticular fimbriae (not socketed at base and thus not setae), the mesal branch longer, more curved; distally fimbriae separate, some with triangular heads. Posterior to mesal branch tight group of three very long flagellalike fimbriae sinuously curved, meeting tips of mesal branch fimbriae. More posterior two-part membranous lamella, the lateral part larger, with small, acute cuticular teeth scattered over posterior surface. Prefemora deeply excavate and lobed mesally to permit passage of lateral branch of anterior gonopod telopodite; distal segment of telopodite enormously enlarged, flattened, appressed to side of metazonite of segment seven.

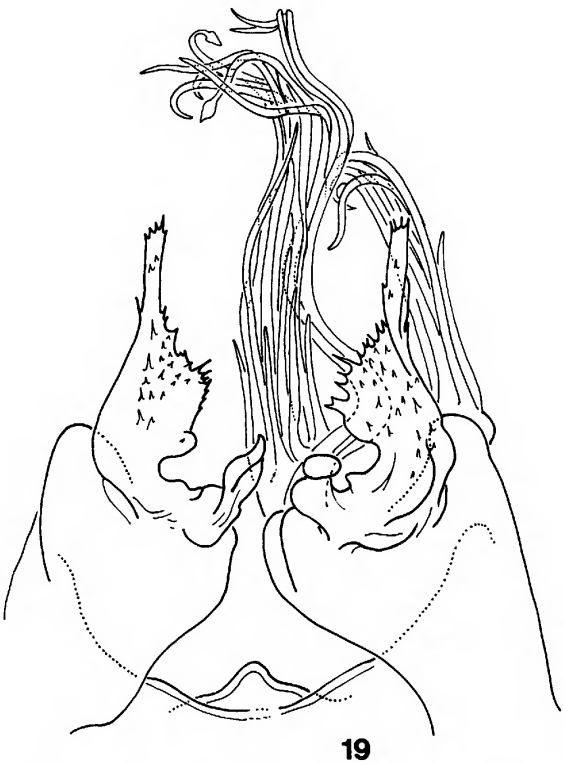


Fig. 19. Colpocoxites of posterior gonopods of *Ancudia chepu,* posterior view. Fimbriate branches of right side not shown.

Coxae of legpair 10 (fig. 18) enlarged, lobed, with large glands; telopodites reduced in size to about ¾ size of legpair 11 telopodites.

FEMALE: Length, 6.8 mm, width 0.96 mm. Antennal segment three 0.25 mm long. Ocelli 24 in subtriangular patch. Pigmentation and nonsexual characters as in male.

ADDITIONAL RECORD: CHILE. Chiloé Prov., Isla de Chiloé, 8 km west of Ancud, in disturbed forest, elev. 60 m, Feb. 1, 1985 (N. Platnick, O. Francke), male, two females, juveniles.

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